

# The Trend of Myocarditis in Mississippi Before and During the Covid-19 Pandemic Era

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**Abstract**— There has been an increased awareness of the inflammation of the heart called myocarditis recently. This inflammation, which causes abnormal heart rhythms can be triggered by the immune system's response to viral infections such as the COVID-19 virus. Recent reports suggest a causal link between COVID-19 and myocarditis. This study aims to compare the trend of myocarditis in Mississippi before the COVID-19 era (2016 – 2019) and during the COVID-19 pandemic (2020-2021). A retrospective study of hospitalizations for myocarditis in the state of Mississippi from 2016 to 2019 was conducted. Then, a record of hospitalization of patients with co-morbidity of myocarditis and COVID-19 from April 1, 2020, to March 31, 2021, was obtained for comparison. All data are from the Mississippi State Department of Health. The hospitalization rate for myocarditis was stable at an annual average of 65 persons between 2016 and 2019. In 2020, 118 hospitalizations representing an 82% increase in hospitalization were recorded. Also, the hospitalization rates were 17 per 100,000 in the pre-COVID era but increased by 100% to 34 per 100,000 hospitalizations during the pandemic. The proportion of COVID-19 patients with myocarditis was highest at the beginning of the pandemic (62% in the second quarter of 2020). By the first quarter of 2021, the proportion has decreased to 48%. There was a spike in the number of myocarditis cases between 2020 and 2021. However, the proportion of myocarditis patients with COVID-19 hospitalization declined steadily from the second quarter of 2020. Since the COVID-19 vaccination started in January 2021, the rise in the cases of acute myocarditis in 2020 may not be attributable to the COVID-19 vaccination. An understanding of the trend of myocarditis and its association with COVID-19 will strengthen the health promotion campaign on vaccination and other COVID-19 prevention strategies.

**Keywords**— Myocarditis, Covid-19, Co-Morbidity, Hospitalization, Vaccination.

## I. INTRODUCTION

Myocarditis, also known as inflammatory cardiomyopathy, is an inflammation of the heart muscles known as myocardium. The most common cause of myocarditis is a viral infection, but other causes include bacteria or fungi infection, parasite infestation, and reactions to a drug. The common symptoms include shortness of breath, chest pain, decreased ability to exercise, and an irregular heartbeat.

Myocarditis is an uncommon cardiovascular disease that affects both old and young people worldwide. It is the third leading cause of sudden death in children and young adults [1]. In 2017, there were 3.1 million cases globally with a prevalence of about 22 cases per 100,000 annually [2]. However, since the onset of the COVID-19 pandemic in December 2019, there has been an uptick in the incidence of myocarditis. Studies suggest a relationship between myocarditis and COVID-19 [3] [4], and

myocarditis have been implicated as the cause of death in some COVID-19 patients [5].

In a study by the Centre for Disease Control and Prevention (CDC), the occurrence of myocarditis inpatient encounters in the US was 42% higher in 2020 than in 2019 and the association between COVID-19 and myocarditis was most pronounced among children and older adults [6]. Approximately 40% of patients with myocarditis had a history of COVID-19 [6]. During the first twelve months of the pandemic (April 2020—March 2021), there were 127 hospitalizations for myocarditis in Mississippi, and 71 (56%) of these patients had a coexisting COVID-19 diagnosis [7]. None of these 127 hospitalizations for myocarditis had a coexisting code for postvaccination adverse effect. During the same period, there were 23 in-hospital deaths among patients with myocarditis, with nearly all (22 out of 23) of these deaths among patients with a COVID-19 diagnosis [7].

Despite the unabating trend in Covid-19 infection rates, Mississippi remains one of the most unvaccinated states in the US. The most recent data shows that only 44% of adult Mississippians have received the second dose of the COVID-19 vaccine and about 51% have received the first dose [8]. Wearing masks and social distancing are some of the measures aimed at minimizing the spread of the virus but acquired immunity through vaccination is believed to be the best way of effectively reducing the morbidity and mortality rates due to the pandemic. However, speculations about the rise in cases of myocarditis following some COVID-19 vaccinations have become one of the factors fueling vaccine skepticism and anti-vaccination sentiments among Mississippians and Americans in general.

A recent study on acute cardiac events following COVID-19 infection or vaccination found that the risk of myocarditis increased within one week of getting the first dose of vaccine (both adenovirus and mRNA vaccines), with higher risk after the second dose [9]. The risk of myocarditis following COVID-19 vaccination was found to be higher among people below the age of 40 years. However, the same study found that the risk of cardiac events, including myocarditis was greater following COVID-19 infection compared to the risk after vaccination. Within one month following COVID-19 vaccination, the extra myocarditis cases were less than 10 per million persons compared to 40 per million persons following COVID-19 infection [9].

### *Purpose of Study*

The purpose of this study is to compare the trend of myocarditis in Mississippi before the COVID era (2016 – 2019) and during the COVID pandemic (2020-2021).

II. METHODOLOGY

A retrospective study of hospitalizations for myocarditis in Mississippi from 2016 to 2019 was conducted. Then, a record of hospitalization of patients with coexisting conditions of myocarditis and COVID-19 from April 1, 2020, to March 31, 2021, was obtained. All data are from the Mississippi State Department of Health. Trends of hospitalizations for myocarditis in Mississippi between 2016 and 2020 were observed. The hospitalization rates (the proportion of myocarditis hospitalizations among all hospitalizations) was used to account for possible variations in the yearly hospital admissions

III. FINDINGS

Figure 1 shows that the hospitalization rate for myocarditis was stable at an annual average of 65 persons between 2016 and 2019 (before the COVID-19 era). But in 2020, 118 hospitalizations were recorded, representing an 82% increase in hospitalization.

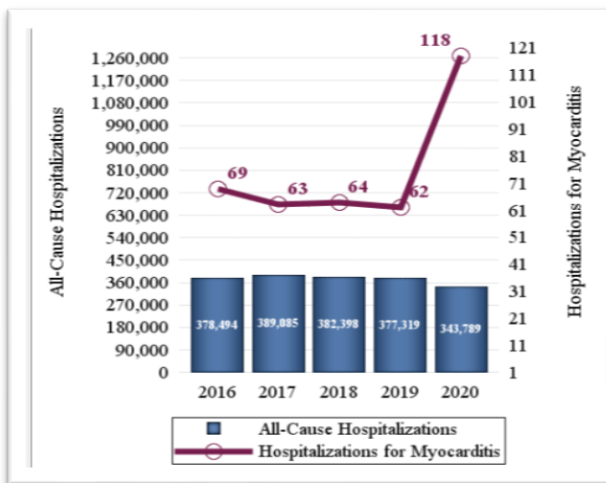


Fig. 1. Hospitalizations for Myocarditis Per Annum, MS, 2016 – 2020

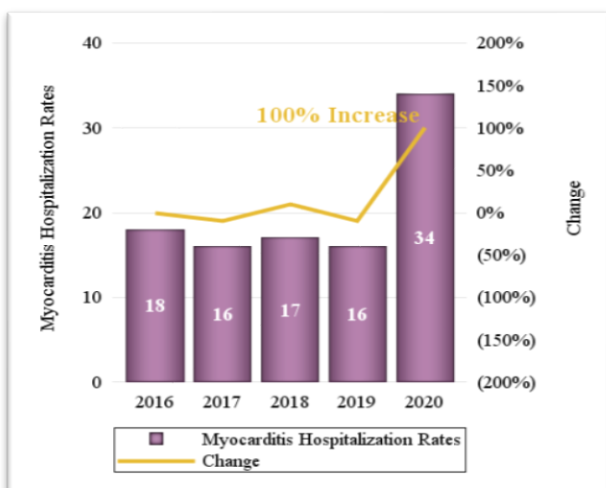


Fig. 2. Myocarditis: Rates per 100K Hospitalizations, MS, 2016 - 2020

Also, between 2016 and 2019, the hospitalization rates (the proportion of myocarditis hospitalizations among all-cause hospitalizations) were 17 per 100,000 in the pre-COVID era but increased by 100% to 34 per 100,000 hospitalizations during the pandemic as shown in Figure 2)

COVID-19-related Myocarditis hospitalization was highest in the third quarter of 2020 but had declined to a level lower than non-COVID-19 related hospitalization by the first quarter of 2021. (Figure 3)

The proportion of COVID-19 patients with myocarditis was highest at the beginning of the pandemic (62% in the second quarter of 2020). By the first quarter of 2021, the proportion has decreased to less than half (48%) of hospitalizations. (Figure 4)

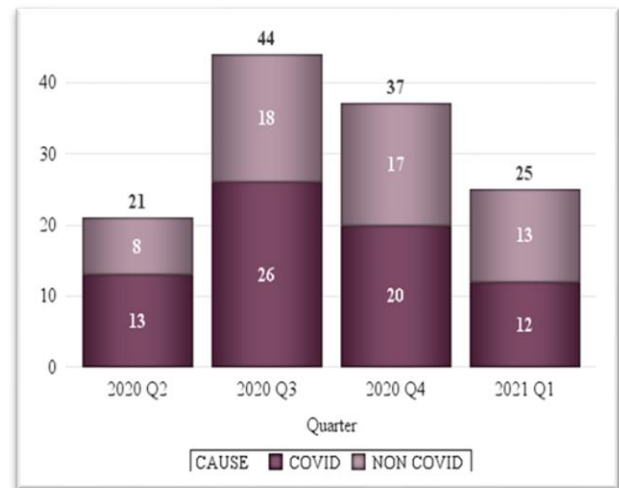


Fig. 3. Number of Myocarditis Hospitalizations per quarter by Cause, MS, 03/01/2020 – 03/31/2021

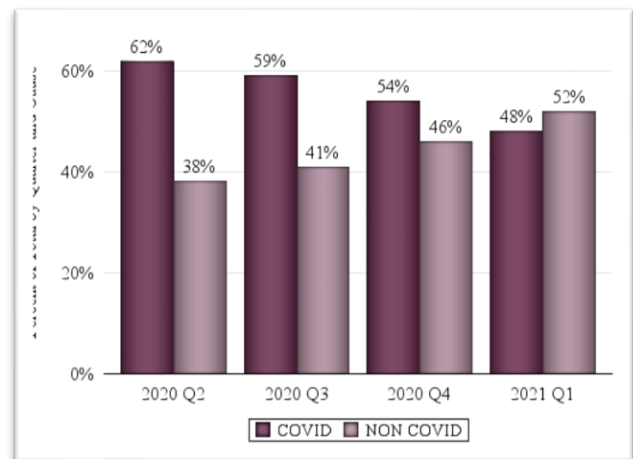


Fig. 4. Percent of Myocarditis Hospitalizations by Quarter and Cause, MS, 03/01/2020 – 03/31/2021

Demographic studies show that older patients were more prone to COVID-19-related myocarditis. Patients 65 years and above accounted for 51% of all hospitalizations with co-morbidity of myocarditis and COVID-19, but this age group was responsible for only 11% of the hospitalizations for myocarditis without a coexisting COVID-19 diagnosis. Among

the races, Caucasians (51%) had the highest hospitalization for COVID-19 and myocarditis followed by African Americans (41%) and other races (8%). Fig 5. Males (55%) were more likely to be hospitalized for co-morbidity than females (45%). (Figure 6)

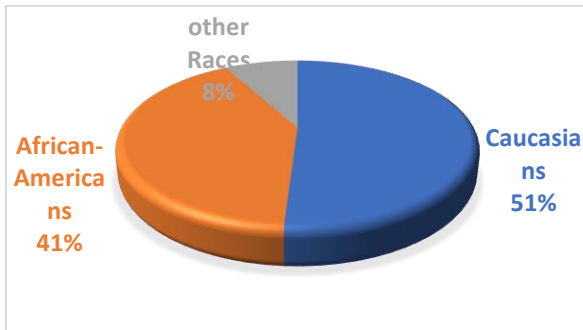


Fig. 5. Hospitalization for COVID-19 and myocarditis by Race in Mississippi in the COVID-19 Era

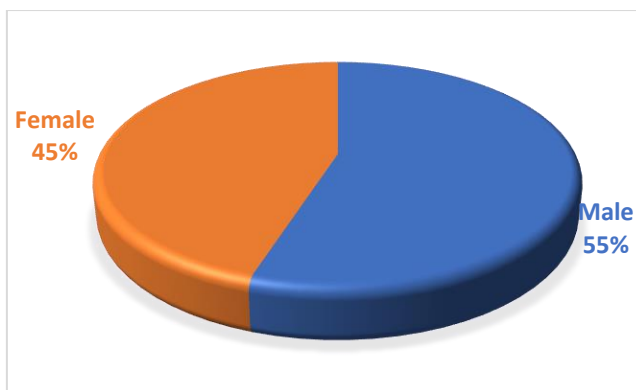


Fig. 6. COVID-19 and Myocarditis by Gender in Mississippi in the COVID Era

In the first twelve months of the COVID-19 era (April 2020—March 2021), there were 127 hospitalizations due to myocarditis in Mississippi, and 71 of these cases (56%) had a coexisting diagnosis for COVID-19. However, none of the 127 cases of myocarditis hospitalizations reported a coexisting code for post-vaccination adverse effects. The number of in-hospital deaths due to myocarditis for the same period was 23 persons and 21 of the mortality was recorded among patients with coexisting Covid-19 diagnosis. The mortality rate for the comorbidity of covid-19 and myocarditis is about 31%. Age was a contributing factor as patients 65 years and older accounted for more than half of the coexisting myocarditis and COVID-19 hospitalizations.

#### IV. DISCUSSION

There was an increase in the number of myocarditis cases between 2020 and 2021 in Mississippi, consistent with the national data. However, the proportion of COVID-19 patients who had myocarditis declined steadily from the second quarter of 2020. A previous CDC study found that the risk for myocarditis among patients diagnosed with COVID-19 was 16 times higher than in those without COVID-19 diagnosis [6] Since the COVID-19 vaccination started in January 2021, it can

be implied that the rise in the cases of acute myocarditis in 2020 is not attributable to COVID-vaccination. Instead, COVID-19-related myocarditis declined in the first quarter of 2021 when vaccination was introduced. Though not conclusive evidence, the findings suggest that the reduced incidence of COVID-19-related myocarditis may be related to the COVID-19 vaccination campaign in Mississippi. Acute myocarditis can be life-threatening, but studies show that vaccine-induced myocarditis is mild, self-limiting, and usually limited to the first 7 days following vaccination [10], while myocarditis following COVID-19 hospitalization has a substantial risk of morbidity and mortality [11]. Data from a different study show that COVID-19 vaccination was associated with a marginal increase in the risk of cardiac events including myocarditis within one week of the first dose and after the second dose of the two approved mRNA vaccines [6]. Conversely, the risk of hospitalization from cardiac outcomes including myocarditis was substantially increased following the COVID-19 infection [6].

#### V. SUMMARY

Understanding the trend of myocarditis and its association with COVID-19 will strengthen the health promotion on vaccination and other COVID-19 prevention strategies. This knowledge will help reduce vaccine hesitancy, improve COVID-19 vaccination rates, and consequently minimize the health impact of the COVID-19 pandemic in the state of Mississippi. Though myocarditis events were not reported following randomized vaccine trials for the COVID-19 vaccines, there is a need for continued monitoring and surveillance especially since there had been reports of myocarditis following other vaccines such as the vaccinia virus vaccine [12] [13].

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